Claims:

1. A sampler capable of extracting sample volumes of substantially single-phase fluid or gas from a fluid-flow system containing multi-phase fluids, said sampler including;

   - a collection recess adapted to separate substantially single-phase fluid from said multi-phase fluid;
   - an extraction outlet in said collection recess;
   - at least one fluid sensor system capable of sensing the presence of a minimum volume of said single-phase fluid or gas in the collection recess, and
   - a fluid controller capable of controlling flow from the collection recess via said extraction outlet;

   characterised in that

   a sample volume of said single-phase fluid or gas is obtainable by operating the fluid controller to allow the sample volume to flow through the extraction outlet after said fluid sensor has detected the presence of said minimum volume of single-phase fluid or gas in the fluid collection recess.

2. A sampler as claimed in claim 1, further including a pump controlled by said fluid controller to extract said sample volume from the collection recess.

3. A sampler as claimed in claim 1, further including a valve controlled by said fluid controller to allow the sample volume to pass from the

collection recess.

4. A sampler as claimed in any one of claims 1-3, wherein the fluid sensor is configured as a fluid level detector.

5. A sampler as claimed in claim 4, wherein said level detector is positioned to detect the presence of single-phase fluid at a position in the collection recess indicative of sufficient single-phase fluid volume to extract said defined volume sample.

6. A sampler as claimed in any one of the preceding claims, wherein additional fluid level detectors are employed to provide data on fluid level change and/or rate of fluid level change.

7. A sampler as claimed in any one of the preceding claims, wherein the fluid sensor is capable of continuously measuring the absolute single-phase fluid level within the collection recess.

8. A sampler as claimed in any one of the preceding claims, wherein the fluid sensor is configurable to detect the absence of fluid or gas, including single or multi-phase fluid, at said predetermined level in the collection recess.

9. A sampler for extracting sample volumes of substantially single-phase fluid or gas from a fluid-flow system containing multi-phase fluids, said sampler including;

- a collection recess adapted to separate substantially single-phase fluid from said multi-phase fluid;

- an extraction outlet in said collection recess;

- at least one fluid sensor system capable of sensing the presence and/or state of said single-phase fluid or gas in the collection recess,

- a fluid controller capable of controlling fluid or gas flow from the collection recess via said extraction outlet;

characterised in that said fluid sensor system includes

at least two distinct sensors respectively capable of utilising distinct properties of the fluid or gas to determine the presence and/or state of the sample volume present in the collection recess.

10. A sampler as claimed in claim 9, wherein said properties of the fluid or gas include transmission/absorption, refractive index, reflectance, back-scattering, opacity, capacitance, inductance, conductivity, electrical resistance, dielectric constant, ultrasonic, magnetic or acoustic.

11. A sampler as claimed in claim 9 or claim 10, wherein said fluid sensor system includes

- a total internal reflection sensor including an emitter and a detector, and

- a transmission sensor including an emitter and a detector arranged on substantially opposing sides of the collection recess.

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12. A sampler as claimed in claim 9, wherein the state of a sample volume determined by the fluid sensor system includes at least one of; single phase fluid, froth, or gas.

13. A fluid sampler as claimed in claim 11 or claim 12, wherein the total internal reflection sensor emitter and detector are orientated towards a common point on a wall of the collection recess and positioned substantially symmetrically either side of an axis orthogonal to the wall and passing through said common point.

14. A sampler as claimed in any one of claims 1 -13, wherein a predetermined or minimum sample volume of said single-phase fluid or gas is obtainable by operating the fluid controller to allow fluid to flow through the extraction outlet for a predetermined period after said fluid sensor system has detected the presence of a predetermined minimum volume of single-phase fluid or gas in the collection recess.

15. A sampler as claimed in any one of claims 11 -14, wherein the total internal reflection sensor and transmission sensor use one of more common emitters and/or detectors.

16. A sampler as claimed in any one of claims 11 -15, wherein each sensor includes an individual emitter and a single detector common to both sensors.

17. A sampler as claimed in any one of claims 11 -16, wherein at least one emitter is a near infra red (NIR) LED.

18. A sampler as claimed in any one of claims 11-17, wherein the detector is a photo-diode.

19. A sampler as claimed in any one of claims 11 -18, wherein the total internal reflection and/or the transmission sensor are/is located at a predetermined level in the collection recess corresponding to said minimum sample volume.

20. A sampler as claimed in any one of claims 9-19, wherein the fluid controller incorporates a processor capable of receiving output signals from all the fluid sensor system sensors and comparing said outputs with predetermined reference data to determine whether single phase fluid, froth, or gas is present in the collection recess.

21. A sampler as claimed in any one of claims 11-20, wherein the total internal reflection sensor is configured such that light emitted from emitter is totally internally reflected to the detector when air is present in the collection recess.

22. A sampler as claimed in claim 21, wherein a least part of the light emitted from emitter is refracted into the collection recess and a consequently reduced intensity light signal is received by the detector when fluid is present in the collection recess.

23. A sampler as claimed in any one of claims 11-22, wherein said fluid sensor system further includes an analogue and digital controllers, said analogue controller capable of processing output signals from said detectors and providing an input signal to said emitters, said digital controller incorporates said processor and interfaces with the analogue controller to receive, process and convert the analogue signals into equivalent digital signals, before the processor compares the detectors outputs with said data records to determination the state of the substance.

24. A sampler as claimed in claim 23, wherein the processor outputs a signal to a display indicating the phase of the medium in the sample recess.

25. A sampler as claimed in claim 23 or claim 24, wherein upon detection of a specific medium in the collection recess, the processor operates a pump to allow said minimum volume of fluid or gas to flow through the extraction outlet.

26. A sampler as claimed in any one of claims 11-25, wherein the input of ambient light on the fluid sensor measurements is eliminated.

27. A sampler as claimed in any one of claims 11-26, wherein the detector output measured with all emitter switched off is subtracted from the detector outputs measured when a transmission emitter or total internal reflection emitter is on.

28. A sampler as claimed in any one of the preceding claims, wherein upon detection by the fluid sensor of the absence of said fluid, the fluid controller may activate said pump or valve to allow the passage of non-dissolved gas to form a substantially non-fluid buffer between single fluid samples.

29. A sampler as claimed in any one of claims 10-28, wherein the opacity of any fluid in the collection recess is determined by the fluid sensor system by comparison of the fluid sensor system detector output with said data records to identify the presence of single phase milk, water, cleaning fluid, or a combination of same.

30. A sampler as claimed in any one of the preceding claims, wherein the detection by the fluid sensor system of the absence of said fluid in the collection recess instigates an evacuation of the collection recess and extraction outlet by pumping un-dissolved gas or a cleaning fluid through any sampler fluid paths.

31. A sampler as claimed in any one of the preceding claims, wherein an entrance to the collection recess from the fluid flow system is raised from the lowermost position of fluid flow in the fluid flow system.

32. A sampler as claimed in claim 31, wherein for a fluid flow system in the form of a cylindrical tubular conduit, the entrance to the collection recess is raised by rotating the conduit about its longitudinal axis by less than 90°, thus rotating the collection recess from the lowermost point of the conduit.

33. A sampler as claimed in claim 32, wherein a raised rim is formed about the collection recess entrance.

34. A sampler as claimed in any one of the preceding claims, wherein the sample volumes extracted from the collection recess are temporarily retained in a storage vessel before transportation to a sample processor.

35. A sampler as claimed in claim 34, wherein said sample storage vessels are fluid conduits connected to corresponding collection recess extraction outlets.

36. A sampler as claimed in any one of claims 34-35, wherein at least one additional fluid sensor is incorporated into the sampler at a downstream position from the extraction outlet.

37. A sampler as claimed in any one of claims 32-34, wherein said additional fluid sensor is located in said storage vessel.

38. A sampler as claimed in any one of the preceding claims, wherein said sampler further includes a sample processor for performing mastitis detection, said sample processor including; an inlet from one or more sample

storage vessels; a mixing chamber, with a reagent inlet and an outlet draining to a flow chamber.

39. A sampler as claimed in any one of claims 9-38, wherein said at least two distinct sensors are capable of distinctive outputs from sensing the sample volume in comparison to sensing any other components of said multi-phase fluid in the fluid flow system.

40. A sampler as claimed in any one of claims 9-39, capable of intermittent extraction of a specific fluid or gas or a specific phase of fluid/gas from a multi flow system, said extraction being halted during periods when one or more unwanted fluid/gas phases are present in the collection recess.

41. A sampler as claimed in any one of the preceding claims, wherein extraction of the sample volume is delayed for a predetermined period after commencement of fluid flow in the fluid flow system.

42. A sampler as claimed in claim 40, wherein commencement of fluid flow is signalled to the sampler from an external source.

43. A sampler as claimed in any one of the preceding claims, wherein the fluid controller may activate said pump or valve to allow the passage of non-dissolved gas to form a substantially non-fluid buffer between individual fluid sample volumes.

44. A sampler as claimed in any one of the preceding claims, wherein the fluid controller may activate said pump or valve to allow the passage of fluid to form fluid buffers between individual gas sample volumes.

45. A sampler as claimed in any one of claims 13-43, wherein a predetermined or minimum sample volume of said single-phase fluid or gas is obtainable by operating the fluid controller to allow fluid to flow

through the extraction outlet until

- a predetermined time has elapsed;
- a pump operable by the fluid controller has pumped said minimum volume from the collection recess;
- a second level sensor located at a lower point in the collection recess indicates the absence of the sample volume fluid or gas; and/or
- a flow rate sensor monitoring flow from the extraction outlet indicates flow has dropped below a predetermined level.

46. A method of intermittent extraction of a specific fluid or gas or a specific phase of fluid/gas from a multi flow system using the sampler as claimed in any one of claims 9-45, said extraction being halted during periods when one or more unwanted fluid/gas phases are present in the collection recess.

47. A method as claimed in claim 46, wherein the wherein extraction of the sample volume is delayed for a predetermined period after commencement of fluid flow in the fluid flow system.

48. A method of configuring a sampler as claimed in any one of claims 11-47, said method including the step of;

- selecting said two or more sensors for the fluid sensor system such that sensing the presence and/or state of a sample volume for subsequent extraction from the collection recess produces a distinct out put from the fluid sensor system sensors in comparison to sensing any other components of said multi-phase fluid in the fluid flow system sensed in the collection recess.

49. A testing method to aid in the detection of mastitis using the sampler as claimed in any one of claims 11-48, said method characterised by the steps of:

- sensing the presence of single-phase fluid in the collection recess at a predetermined height;
- activating said pump for a predetermined period to extract a defined or minimum volume of single-phase fluid sample via the fluid extraction outlet;
- transporting the fluid sample to the mixing chamber in said sample processor;
- mixing a reagent with the fluid sample to form a gel;
- obtaining an indication of somatic cell numbers by measuring the time the gel needs to drain through a defined exit hole;
- determining if the drain time exceed a predetermined threshold value or range of values.

50. A method as claimed in claim 49, wherein said viscosity measurement is performed by monitoring the time taken to drain the gel though a fixed size outlet.

51. A method as claimed in claim 49 or claim 50, wherein one or more fluid sample(s) is/are temporarily stored in one or more sample storage vessel(s) before transportation to the sample processor.

52. A method of sensing single-phase fluid, froth, or gas medium in a collection recess of a sampler as claimed in any one of claims 11-45, said method including:

- sensing said medium in the collection recess with said at least two sensors using said distinct properties of the fluid or gas;
- outputting the signals detected by said two or more sensors to the fluid controller;
- comparing the detected signals with data records relating to single phase fluids, froth and/or gas to determine the medium present in the collection recess.

53. A method of sensing single-phase fluid, froth, or gas medium in a collection recess of a sampler as claimed in any one of claims 11-45, said method including:

- emitting light from the transmission sensor emitter into the collection recess and detecting with the transmission sensor detector the light transmitted through the collection recess;
- emitting light from the total internal reflection sensor emitter and detecting with the total internal reflection sensor detector the light totally internally reflected from the wall of the collection recess;
- outputting the signals detected by the transmission and total internal reflection sensor detector(s) to the fluid controller;
- comparing the detected signals with data records relating to single phase fluids, froth and/or gas to determine the medium present in the collection recess.

54. A sampler substantially as hereinbefore described, with respect to and as show in the accompanying drawings.

55. A method of intermittent extraction of a specific fluid or gas or a specific phase of fluid/gas from a multi flow system substantially as hereinbefore described, with respect to and as show in the accompanying drawings.

56. A testing method to aid in the detection of mastitis substantially as hereinbefore described, with respect to and as show in the accompanying drawings.

57. A method of sensing single-phase fluid, froth, or gas medium in a collection recess of a sampler substantially as hereinbefore described, with respect to and as show in the accompanying drawings.